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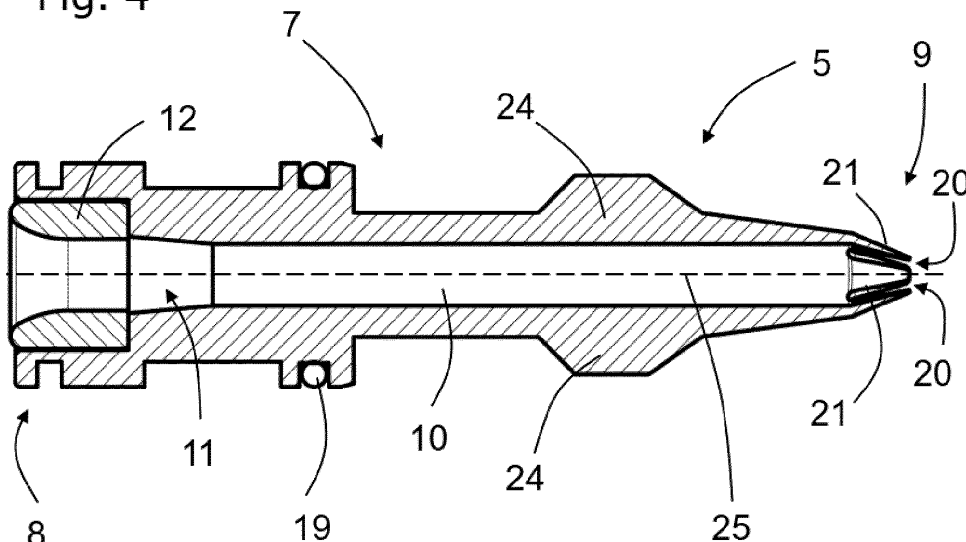
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(54) **NOZZLE INSERT, NOZZLE DEVICE WITH A NOZZLE INSERT, AND METHOD FOR MANUFACTURING A NOZZLE INSERT**

(57) The invention relates to a nozzle insert (5) for a nozzle device (1) for an airjet weaving machine, comprising a tubular main body (7) with an inlet end (8), an outlet end (9), and a weft channel (10) extending from the inlet end (8) towards the outlet end (9), wherein the outlet end (9) is provided with three or more notches (20), such that protrusions (21) extending in an axial direction of the tu-

bular main body (7) are formed at the outlet end (9), and wherein the protrusions (21) are sloped with respect to an adjoining segment of the tubular main body (7) towards a centerline (25) of the tubular main body (7). The invention further relates to a nozzle device (1), and to a method for manufacturing a nozzle insert (5).

Fig. 4



Description

TECHNICAL FIELD AND PRIOR ART

[0001] The invention relates to a nozzle insert for a nozzle device of an airjet weaving machine. The invention further relates to a nozzle device, and to a method for manufacturing a nozzle insert.

[0002] Nozzle devices, also referred to as insertion nozzle devices, having a channel and a nozzle insert arranged in said channel, which nozzle devices are used to insert weft threads into a shed of a weaving machine are well known in the prior art. Nozzle inserts typically have a tubular main body with an inlet end, an outlet end, and a weft channel extending from the inlet end towards the outlet end, via which weft channel the weft thread is supplied for an insertion. The air used for transporting the weft thread is supplied via the channel, in which the nozzle insert is arranged. Nozzle devices can have a number of channels, for example two, four, six or eight channels.

[0003] For example, US5697405 describes a nozzle device with a nozzle insert, wherein the nozzle insert is provided with several protrusions at an outlet end of the nozzle insert. Nozzle devices with notches between the protrusions allow catching ends of cut-off or broken weft threads for preventing a weft thread from "jumping back" (this means moving in a direction opposite to an insertion direction) into the nozzle insert or even out of the nozzle insert after the inserted weft thread is cut-off. However, providing nozzle inserts with notches and protrusions at an outlet end may impair a weft insertion speed. Therefore, any advantages of possibly preventing a pulling back using such prior art nozzle inserts are not sufficient for justifying the disadvantages during the weft insertion.

SUMMARY OF THE INVENTION

[0004] It is an object of the invention to provide a nozzle insert for a nozzle device of an airjet weaving machine allowing to prevent a pulling back of a weft thread while reducing or avoiding an impair of an airflow in the nozzle device. Further objects are to provide a nozzle device with such a nozzle insert and a method for manufacturing a nozzle insert.

[0005] According to a first aspect, a nozzle insert for a nozzle device for an airjet weaving machine is provided, the nozzle insert comprising a tubular main body with an inlet end, an outlet end, and a weft channel extending from the inlet end towards the outlet end, wherein the outlet end is provided with three or more notches, such that protrusions extending in an axial direction of the tubular main body are formed at the outlet end, and wherein the protrusions are sloped with respect to an adjoining segment of the tubular main body towards a centerline of the tubular main body.

[0006] In the context of the application, the expression "sloped with respect to an adjoining segment of the tu-

bular main body" describes an arrangement of the protrusions such that a bend or kink is formed at a transition between the adjoining segment and the protrusions at least at an outer surface of the tubular main body. In embodiments, the protrusions are sloped with respect to the adjoining segment of the tubular main body such that a bend or kink is formed at transitions between the adjoining segment and the protrusions at the outer surface of the tubular main body and at an inner surface of the tubular main body, i.e. at the weft channel extending through the tubular main body.

[0007] When providing sloped protrusions, a cross section of an annular ring provided between the nozzle insert and a channel, in which the nozzle insert is arranged, is increased at a transition between the protrusions and the adjoining section of the tubular main body. Hence, in an area of a smallest cross section, upstream of the protrusions, the tubular main body has a smooth surface. Hence, an airflow is less disturbed compared to prior art devices having protrusions extending the adjoining section without any bend or kink. At the same time, catching cut-off weft threads is improved due to the sloped arrangement of the protrusions towards the centerline of the weft channel.

[0008] In an embodiment, three or four protrusions are provided. In other embodiments, a larger number of protrusions, for example five or more protrusions is provided.

[0009] In an embodiment, the outlet end is provided with four evenly distributed notches. Providing four notches allows a reliable production of the sloped protrusions and has shown to be sufficient for reliably catching cut-off weft threads.

[0010] In an embodiment, the tubular main body has a conical segment adjoining the protrusions, wherein an outer diameter of the conical segment decreases towards the outlet end, and wherein an outer angle of the conical segment with respect to the centerline of the tubular main body is smaller than an outer angle of the protrusions with respect to the centerline of the tubular main body. In other words, the conical segment and the protrusions each are tapered towards the distal end of the tubular main body, wherein a taper angle of the protrusions is larger than the taper angle of the conical segment.

[0011] In an embodiment, upstream of the conical segment the tubular main body has a constant diameter segment with several radially protruding fins. The radial protruding fins provide a correct positioning of the tubular main body in the channel of the nozzle device and allow a guidance of air around the tubular main body.

[0012] In an embodiment, the tubular main body has radially protruding fins, in particular four radially protruding fins. In embodiments, the radially protruding fins are offset to the protrusions at the outlet end in a circumferential direction. In other embodiments, the radially protruding fins are aligned in the circumferential direction with protrusions provided at the outlet end. This alignment is advantageous for a guidance of air through the nozzle device towards the weft thread.

[0013] In an embodiment, a separate top piece is provided at a front end of the tubular main body, wherein the notches and protrusions are provided in the separate top piece. The top piece is attached fixedly or replaceably to the tubular main body. In other embodiments, the protrusions are formed integrally with the tubular main body.

[0014] In an embodiment, the protrusions have a trapezoidal or triangular form, i.e. a width of the protrusions in the circumferential direction decreases towards the distal end. With this design, an interference of the sloping protrusions is avoided.

[0015] According to a second aspect a nozzle device for an airjet weaving machine is provided, the nozzle device having a channel and a nozzle insert comprising a tubular main body with an inlet end, an outlet end, and a weft channel extending from the inlet end towards the outlet end, wherein the outlet end is provided with three or more notches, such that protrusions extending in an axial direction of the tubular main body are formed at the outlet end, wherein the protrusions are sloped with respect to an adjoining segment of the tubular main body towards a centerline of the tubular main body, and wherein the nozzle insert is arranged in the channel.

[0016] Throughout this application and the claims, the indefinite article "a" or "an" means "one or more". In particular, the nozzle device in embodiments has several channels, wherein in each channel a nozzle insert is arranged.

[0017] In an embodiment, a cross section of an annular ring formed around the protrusions of the nozzle insert arranged in the channel increases towards a free end of the protrusions. Hence, outside the protrusions, an air-flow is decelerated in the insertion direction.

[0018] In embodiments, the channel has a larger diameter section, a smaller diameter section, and a conical section extending between the larger diameter section and the smaller diameter section, wherein the protrusions are surrounded by the conical section and/or the smaller diameter section.

[0019] In case the protrusions are surrounded by the conical section and/or the smaller diameter section, an outer angle of the conical section with respect to the centerline of the tubular main body is smaller than an outer angle of the protrusions with respect to the centerline of the tubular main body, such that a cross section of an annular ring formed around the protrusions of the nozzle insert arranged in the channel increases towards a free end of the protrusions.

[0020] According to a third aspect, a method for manufacturing a nozzle insert having three or more sloped protrusions provided at the outlet end is provided, wherein the method comprises deforming the protrusions for forming protrusions that are sloped with respect to an adjoining segment of the tubular main body towards the centerline of the tubular main body. In other words, according to this method, at a nozzle insert having protrusions extending the adjoining segment, in particular a conical adjoining segment, the protrusions are subse-

quently deformed with respect to the adjoining segment.

[0021] In an embodiment, for deforming the protrusions, a caliber having a conical recess is used. In the context of the invention, the expression caliber is used for describing a die, which die is similar to a neck sizing die, having main body with a boring into which the nozzle insert is inserted for deforming the protrusions.

[0022] In an embodiment, the protrusions are formed by machining the tubular main body, in particular, in embodiments the protrusions are cut into an outlet end of the tubular main body.

[0023] Although the method described above is advantageous for manufacturing the nozzle insert, the invention is not limited to this manufacturing method.

[0024] For example, according to an alternative embodiment, a nozzle insert having sloped protrusions is manufactured using an additive manufacturing process, for example 3D printing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] In the following, embodiments of the invention will be described in detail with reference to the drawings. Throughout the drawings, the same elements will be denoted by the same reference numerals.

Fig. 1 shows a sectional view of an embodiment of a nozzle device with a nozzle insert;

Fig. 2 shows a detail II of the nozzle device of Fig. 1;

Fig. 3 shows in a side view the nozzle insert of the nozzle device of Fig. 1;

Fig. 4 shows in a sectional side view the nozzle insert of Fig. 3;

Fig. 5 shows in a perspective view the nozzle insert of Fig. 3;

Fig. 6 shows in a front view the nozzle insert of Fig. 3;

Fig. 7 shows in a front view a nozzle insert of a second embodiment similar to Fig. 6; and

Fig. 8 shows a tool used for manufacturing the nozzle insert of Fig. 3 or 7.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0026] Fig. 1 shows a nozzle device 1 for inserting a weft thread 2 into a shed of an airjet weaving machine (not shown). Fig. 2 shows a detail of the nozzle device 1 of Fig. 1. Figs. 3 to 6 show a nozzle insert 5 for the nozzle device 1 of Fig. 1 in several views in isolation.

[0027] The nozzle device 1 shown in Fig. 1 comprises a housing 3 and several channels 4. The nozzle device

1 for example has a number of channels 4, wherein in the sectional view of Fig. 1 two channels 4 are visible. The nozzle device 1 in embodiments has four channels 4. In other embodiments it has more or less than four channels 4. In each channel 4, a nozzle insert 5 and an outlet tube 6 are arranged. The outlet tube 6 is arranged in the channel 4 downstream of the nozzle insert 5 in an insertion direction 18 indicated by an arrow. The insertion direction 18 extends in the axial direction of the tubular main body 7 or in the direction of the weft thread 2.

[0028] The nozzle insert 5 shown in Figures 1 to 6 has tubular main body 7 with an inlet end 8, an outlet end 9, and a weft channel 10 extending from the inlet end 8 towards the outlet end 9.

[0029] In the embodiment shown, the outlet tube 6 is arranged downstream of the nozzle insert 5 and at a distance from the outlet end 9 of the nozzle insert 5. In other embodiments, the outlet end 9 of the nozzle insert 5 extends into the outlet tube 6. In still other embodiments, an intermediate piece having a channel is provided between the nozzle insert 5 and the outlet tube 6, wherein the outlet end 9 of the nozzle insert 5 extends into a first section of the channel of the intermediate piece and the outlet tube 6 is placed in a second section of the channel of the intermediate piece.

[0030] The nozzle device 1 shown in Fig. 1 has several channels 4 for forming several weft insertion nozzles, and allows several weft threads 2 to be supplied simultaneously or at different times. In each channel 4, a nozzle insert 5 is arranged. In preferred embodiments, all nozzle inserts 5 of the device 1 are identical in design. However, in other embodiments the nozzle device comprises several nozzle inserts 5, wherein the nozzle inserts differ in design. In still another embodiment, a nozzle device is provided, which is configured for the insertion of one weft thread 2, wherein the nozzle device 1 comprises exactly one nozzle insert 5 arranged in one channel 4.

[0031] In the embodiment shown, the weft channel 10 has a circular cross section. At the inlet end 8, a guiding ring 12 is arranged inside the weft channel 10. The outlet end 9 is provided in the embodiment shown with four notches 20 (see Figs. 2 to 5), such that protrusions 21 extending in an axial direction of the tubular main body 7 are formed at the outlet end 9, which will be described in more detail below.

[0032] Downstream of the guiding ring 12, in an entry section 11 of the weft channel 10, a diameter of the weft channel 10 decreases. Between the entry section 11 of the weft channel 10 and the protrusions 21 provided at outlet end 9, the diameter of the weft channel 10 is constant.

[0033] The channel 4, in which the nozzle insert 5 is provided, has a larger diameter section 13, a smaller diameter section 14, arranged downstream of the larger diameter section 13 in the insertion direction 18, and a conical section 15 extending between the larger diameter section 13 and the smaller diameter section 14.

[0034] At the larger diameter section 13, a duct 16 for a supply of compressed air to the channel 4 is formed in the housing 3, wherein as schematically shown by arrows 17 in Fig. 2, the compressed air flows around the nozzle insert 5 towards the outlet end 9 of the nozzle insert 5. Downstream of the outlet end 9, the compressed air interacts with the weft thread 2 and forces the weft thread 2 to move in the insertion direction 18. When using high air pressures, a secondary air flow 26 (schematically indicated as an arrow in Fig. 1) is flowing through the weft channel 10. When using low air pressures, a small air flow can be sucked through the weft channel 10.

[0035] A sealing ring 19 is provided at the nozzle insert 5 for sealing the nozzle insert 5 against the housing 3.

[0036] As can be best seen in Fig. 6, the outlet end 9 of the nozzle insert 5 is provided with at least three, in the embodiment shown with four notches 20, such that four protrusions 21 extending in the axial direction of the tubular main body 7 of the nozzle insert 5 are formed at the outlet end 9. In the embodiment shown, the notches 20 are cut into the tubular main body 7. In other embodiments, the notches 20 are formed when forming the tubular main body 7, for example when forming the tubular main body 7 by 3D printing or other additive manufacturing methods. In still other embodiments, an adapter having notches and protrusions is provided, which is fixed to the tubular main body 7.

[0037] The protrusions 21 are sloped with respect to an adjoining segment of the tubular main body 7 towards a centerline 25 of the tubular main body 7, such that free or distal ends of the protrusions 21 are located closer to the centerline 25 of the nozzle insert 5 than opposite ends of the protrusions 21. In the embodiment shown, the adjoining segment is a conical segment 23. The centerline 25 of the tubular main body 7 extends in the axial direction of the tubular main body 7 of the nozzle insert 5.

[0038] In order to form the sloped protrusions 21, in embodiments after cutting the notches 20 out of the tubular main body 7, the protrusions 21 are deformed such that a bend or kink is formed at a transition between the adjoining segment, i.e. the conical segment 23 in the embodiment shown, and the protrusions 21 at an outer surface of the tubular main body 7 and in the weft channel 10. In other embodiments, in particular when forming the protrusions 21 in an additive manufacturing method, the weft channel has no bend or kink and only at an outside surface of the tubular main body 7 a bend or kink is provided. In still other embodiments, a bend or kink is formed at a transition region in the weft channel also when using an additive manufacturing process in order to minimize a thickness decrease of the protrusions towards the distal end.

[0039] In the embodiment shown, the protrusions 21 have a trapezoidal or triangular shape, so that a width of the protrusions 21 decreases towards the free or distal end in order to avoid any interference of adjacent protrusions 21 due to a sloped arrangement of the protrusions 21. An outer angle B of the protrusions 21, i.e. an outer

angle A of the outer surface of the protrusions 21, with respect to the centerline 25 of the tubular main body 7, also referred as angle of slope, (see Fig. 2) and a length of the protrusions 21 are adapted to the circumstances in order to ensure that the free ends of the protrusions 21 do not touch each other and to ensure that an opening 22 is formed at the outlet end 9, which is sufficiently large to allow a weft thread 2 to move in the insertion direction 18 to pass the opening 22 without being caught by the protrusions 21.

[0040] The nozzle insert 5 shown in the Figures 1 to 6 is provided with several, more particular four radially protruding fins 24 forming four air guiding passages for guiding the compressed air supplied via the duct 16 to the nozzle insert 5. For the lower nozzle insert 5 of Fig. 1 the air is only guided via a duct 16, while for the upper nozzle insert 5 of Fig. 1 the air is guided via the duct 28 around the outlet tubes 6, the duct 27 and the duct 16. Each nozzle insert 5 is fixed to the housing 3 by a bolt 29. The radially protruding fins 24 are arranged in the larger diameter section 13 of the channel 4. Between the radially protruding fins 24 and the protrusions 21 at the outlet end 9, the nozzle insert 5 is provided with the conical segment 23, wherein in the conical segment 23 an outer diameter of the nozzle insert 5 decreases towards the outlet end 9. The nozzle insert 5 is arranged in channel 4 such that the conical segment 23 and the protrusions 21 are surrounded by the conical section 15 of the channel 4. An outer angle A of the conical segment 23, i.e. the outer angle A of the outer surface of the conical segment 23, with respect to the centerline 25 is smaller than the outer angle B of the protrusions 21 with respect to the centerline 25.

[0041] In the embodiment shown, as shown in Fig. 2 an inner angle C of the conical section 15 of the channel 4, i.e. the inner angle C of the inner surface of the conical section 15, is larger than the outer angle A of the conical segment 23 of the nozzle insert 5 such that - in the insertion direction 18 - a cross section of an annular ring 30 formed between the nozzle insert 5 and the housing 3 decreases with the decrease of the outer diameter of the nozzle insert 5 along the conical segment 23. In an alternative embodiment (not shown), an inner angle C of the conical section 15 of the channel 4 is equal to the outer angle A of the conical segment 23 of the nozzle insert 5. However, the inner angle C of the conical section 15 of the channel 4 is smaller than the outer angle B of the protrusions 21 such that - in the insertion direction 18 - a cross section of the annular ring 30 formed between the nozzle insert 5 and the housing 3 increases with a decrease of the outer diameter of the nozzle insert 5 along the protrusions 21.

[0042] When the compressed air reaches the outlet end 9, the compressed air is expanded. The protrusions 21, which are sloped towards the centerline 25 of the nozzle insert 5, allow the compressed air to expand in an area outside of the protrusions 21. By providing protrusions 21, which are sloped towards the centerline 25

of the nozzle insert 5, turbulences in the flow of compressed air can be avoided or at least reduced.

[0043] When a supply of compressed air through the associated channel 4 is interrupted, and the weft thread 2 after an insertion and a beat-up is cut-off, a cut-off end of the weft thread 2 that - for example due to an elasticity of the weft thread 2 - moves backwards, i.e. opposite to the insertion direction 18, can be caught in one of the notches 20. As due to the sloped arrangement of the protrusions 21, a size of the opening 22 is decreased compared to a design having straight protrusions 21, the cut-off ends of the weft thread 2 can be reliably caught in the notches 20.

[0044] Further, due to the decreased size of the opening 22 resulting from a sloped arrangement of the protrusions 21, the secondary airflow 26 through the weft channel 10 can be decreased compared to a design having straight protrusions 21. Thereby, an amount of air flowing through the weft channel 10 can be decreased, which is advantageous for the weft insertion speed.

[0045] As best seen in Fig. 6, in the embodiment shown in Figs. 1 to 6, the four radially protruding fins 24 provided at the tubular main body 7 are aligned in a circumferential direction with the four protrusions 21 provided at the outlet end 9.

[0046] Fig. 7 shows in a front view a nozzle insert 5 of a second embodiment, which is similar to the nozzle insert 5 shown in Figs. 1 to 6 and also provided with four sloped protrusions 21. In contrast to the embodiment shown in Figs. 1 to 6, according the second embodiment, the four radially protruding fins 24 provided at the tubular main body 7 are offset by 45° in a circumferential direction with respect to the four protrusions 21 provided at the outlet end 9.

[0047] Fig. 8 shows a tool used for manufacturing the nozzle insert 5 of Fig. 6 or Fig. 7, in particular for deforming the protrusions 21, such that the protrusions 21 are sloped with respect to the adjoining segment of the tubular main body 7.

[0048] The tool shown in Fig. 8 is a caliber 100, having main body 101 with a boring 102 into which the nozzle insert 5 (see Fig. 3) is inserted for deforming the protrusions 21. A form of the boring 102 is adapted to the outer shape of the nozzle insert 5. At a portion of the boring 102, which receives the protrusions 21 of the nozzle insert 5, a conical recess 103 is provided. The nozzle insert 5 is pushed into the boring 102, such that the protrusions 21 provided at the outlet end 9 are deformed by means of the conical recess 103. In order to avoid an unintended deformation of the weft channel 10 inside the nozzle insert 5 (see Figs. 1 to 7), in embodiments a mandrel (not shown) is used, which is inserted in the weft channel 10 of the nozzle insert 5 before deforming the protrusions 21.

[0049] The caliber 100 allows for a simple manufacturing of nozzle inserts 5 having sloped protrusions at an outlet end 9. However, the invention is not limited to nozzle inserts 5 manufactured using a caliber 100.

Claims

1. Nozzle insert for a nozzle device (1) for an airjet weaving machine, comprising a tubular main body (7) with an inlet end (8), an outlet end (9), and a weft channel (10) extending from the inlet end (8) towards the outlet end (9), wherein the outlet end (9) is provided with three or more notches (20), such that protrusions (21) extending in an axial direction of the tubular main body (7) are formed at the outlet end (9), **characterized in that** the protrusions (21) are sloped with respect to an adjoining segment of the tubular main body (7) towards a centerline (25) of the tubular main body (7). 5
2. The nozzle insert according to claim 1, **characterized in that** the outlet end (9) is provided with four evenly distributed notches (20). 10
3. The nozzle insert according to claim 1 or 2, **characterized in that** the tubular main body (7) has a conical segment (23) adjoining the protrusions (21), wherein an outer diameter of the conical segment (23) decreases towards the outlet end (9), and wherein an outer angle (A) of the conical segment (23) with respect to the centerline (25) of the tubular main body (7) is smaller than an outer angle (B) of the protrusions (21) with respect to the centerline (25) of the tubular main body (7). 15 20 25
4. The nozzle insert according to claim 3, **characterized in that** upstream of the conical segment (23) the tubular main body (7) has a constant diameter segment with several radially protruding fins (24). 30
5. The nozzle insert according to claim 4, **characterized in that** the tubular main body (7) has radially protruding fins (24), in particular four radially protruding fins (24), wherein the radially protruding fins (24) are aligned in a circumferential direction with the protrusions (21) provided at the outlet end (9). 35
6. The nozzle insert according to any one of claims 1 to 5, **characterized in that** the protrusions (21) are formed integrally with the tubular main body (7). 40
7. The nozzle insert according to any one of claims 1 to 6, **characterized in that** the protrusions (21) have a trapezoidal or triangular form. 45
8. Nozzle device for an airjet weaving machine, the nozzle device (1) having a channel (4), **characterized in that** the nozzle device (1) further comprises a nozzle insert (5) according to any one of claims 1 to 7, wherein the nozzle insert (5) is arranged in the channel (4). 50 55
9. The nozzle device according to claim 8, **characterized in that** a cross section of an annular ring (30) formed around the protrusions (21) of the nozzle insert (5) arranged in the channel (4) increases towards a free end of the protrusions (21).
10. The nozzle device according to claim 8 or 9, **characterized in that** the channel (4) has a larger diameter section (13), a smaller diameter section (14), and a conical section (15) extending between the larger diameter section (13) and the smaller diameter section (14), wherein the protrusions (21) are surrounded by the smaller diameter section (14) and/or the conical section (15).
11. The nozzle device according to claim 10, **characterized in that** an outer angle (A) of the conical section (15) with respect to the centerline (25) of the tubular main body (7) is smaller than an outer angle (B) of the protrusions (21) with respect to the centerline (25) of the tubular main body (7), such that a cross section of an annular ring (30) formed around the protrusions (21) of the nozzle insert (5) arranged in the channel (4) increases towards a free end of the protrusions (21).
12. Method for manufacturing a nozzle insert according to any one of claims 1 to 7 having three or more protrusions (21) provided at the outlet end (9), **characterized in that** the method comprises deforming the protrusions (21) for forming protrusions (21) that are sloped with respect to an adjoining segment of the tubular main body (7) towards the centerline (25) of the tubular main body (7).
13. The method for manufacturing a nozzle insert according to claim 12, **characterized in that** a caliber (100) having a conical recess (103) is used for deforming the protrusions (21).
14. The method for manufacturing a nozzle insert according to claim 12 or 13, **characterized in that** the protrusions (21) are formed by machining the tubular main body (7).
15. Method for manufacturing a nozzle insert according to any one of claims 1 to 7 having three or more protrusions (21) provided at the outlet end (9), **characterized in that** the nozzle insert (5) is manufactured using an additive manufacturing process.

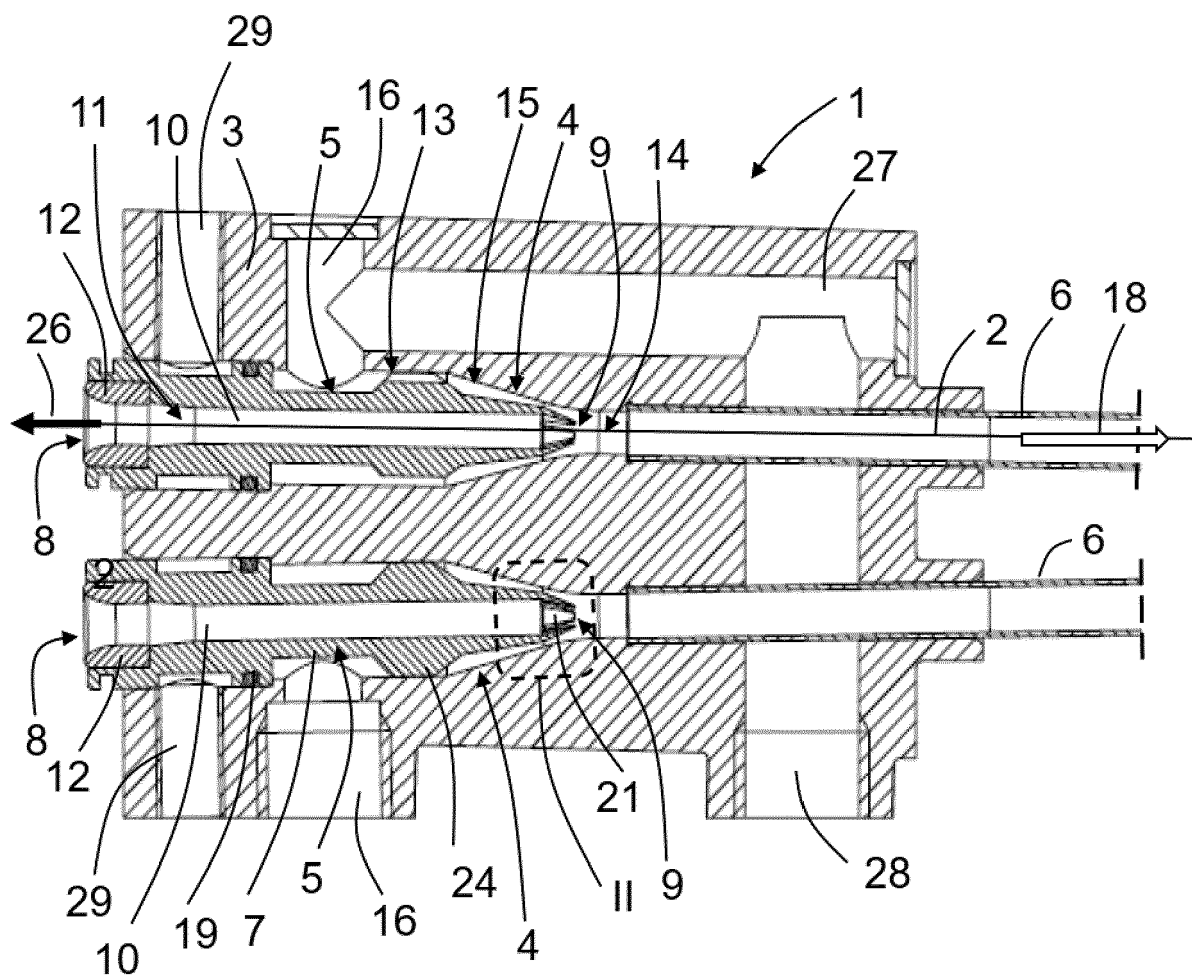


Fig. 1

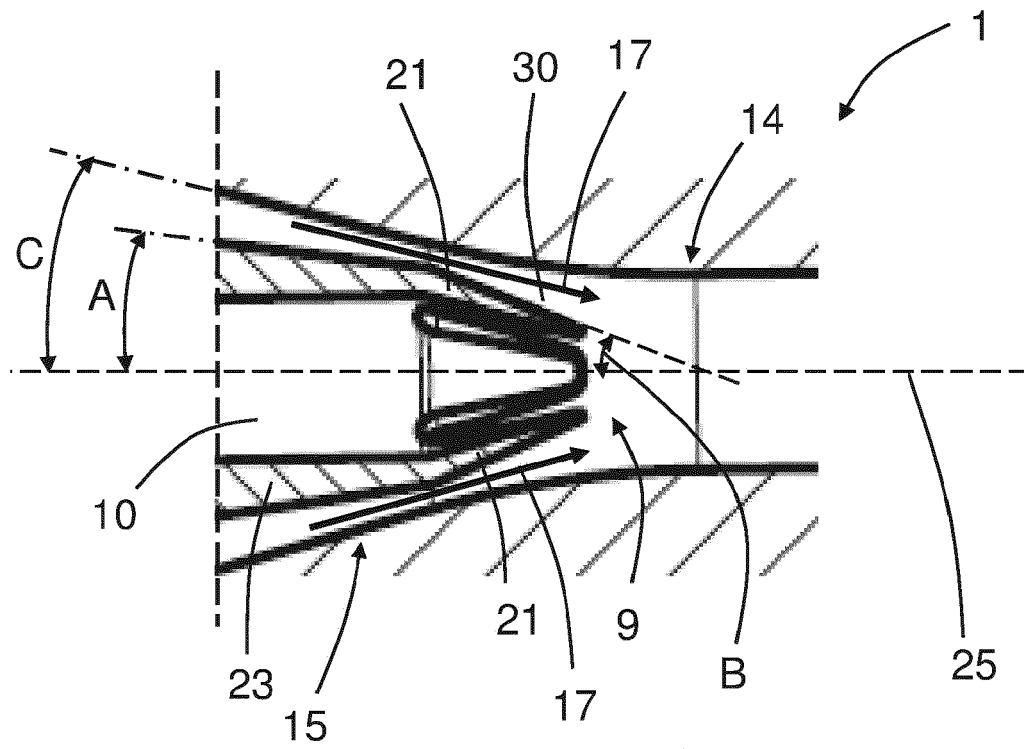


Fig. 2

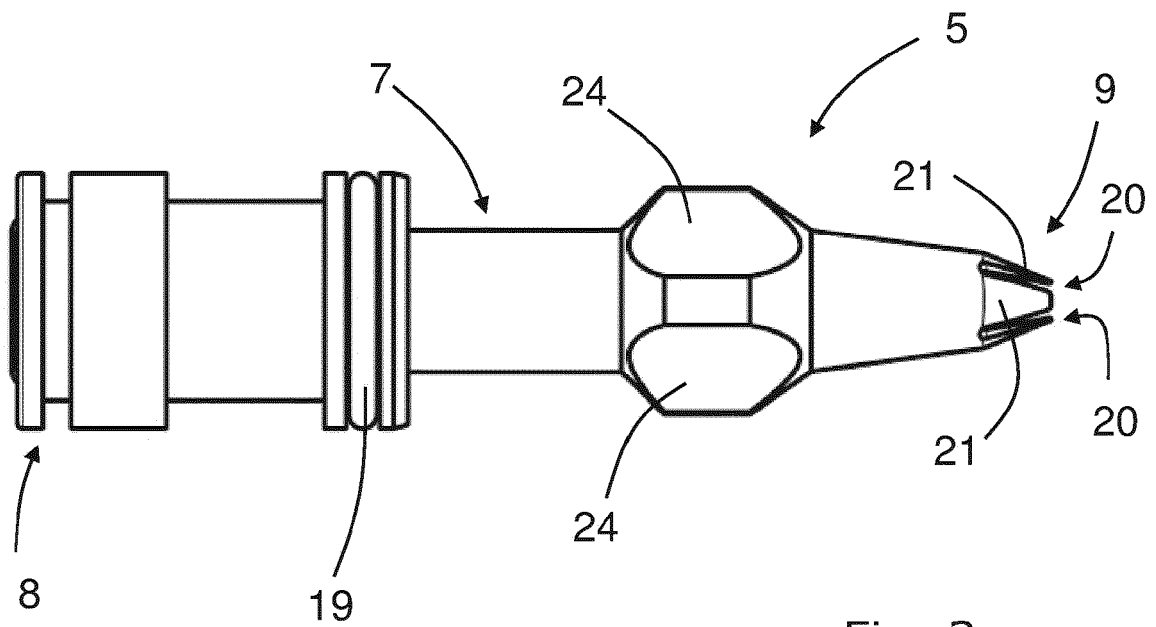


Fig. 3

Fig. 4

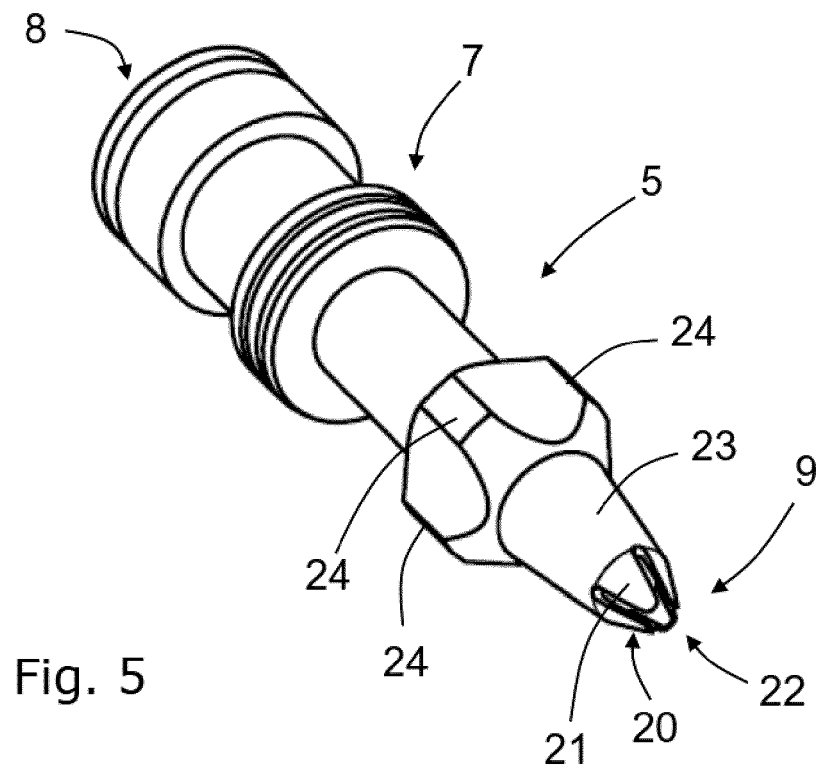
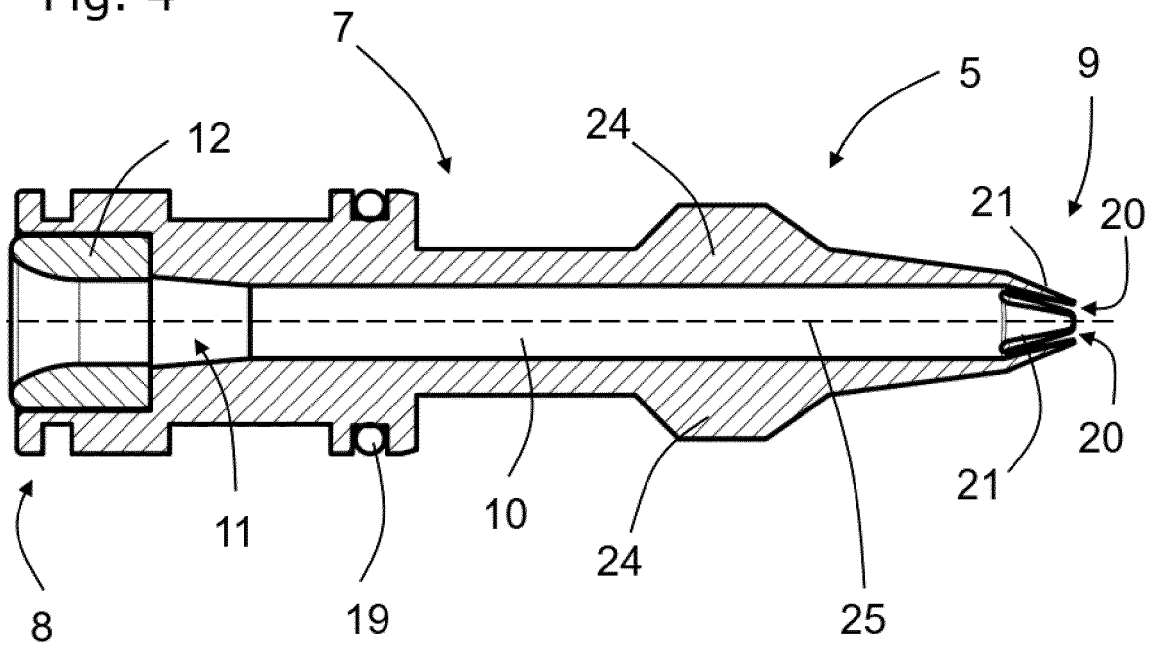


Fig. 5

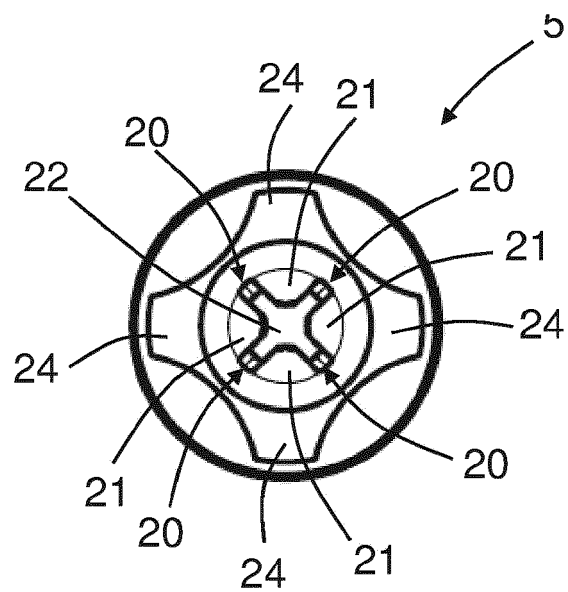


Fig. 6

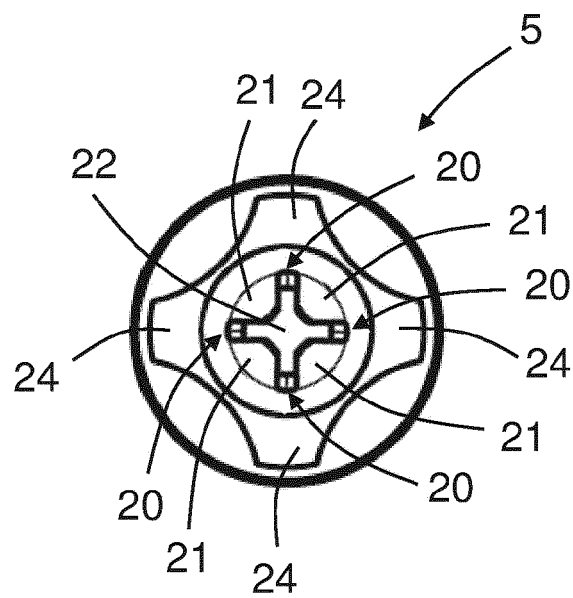


Fig. 7

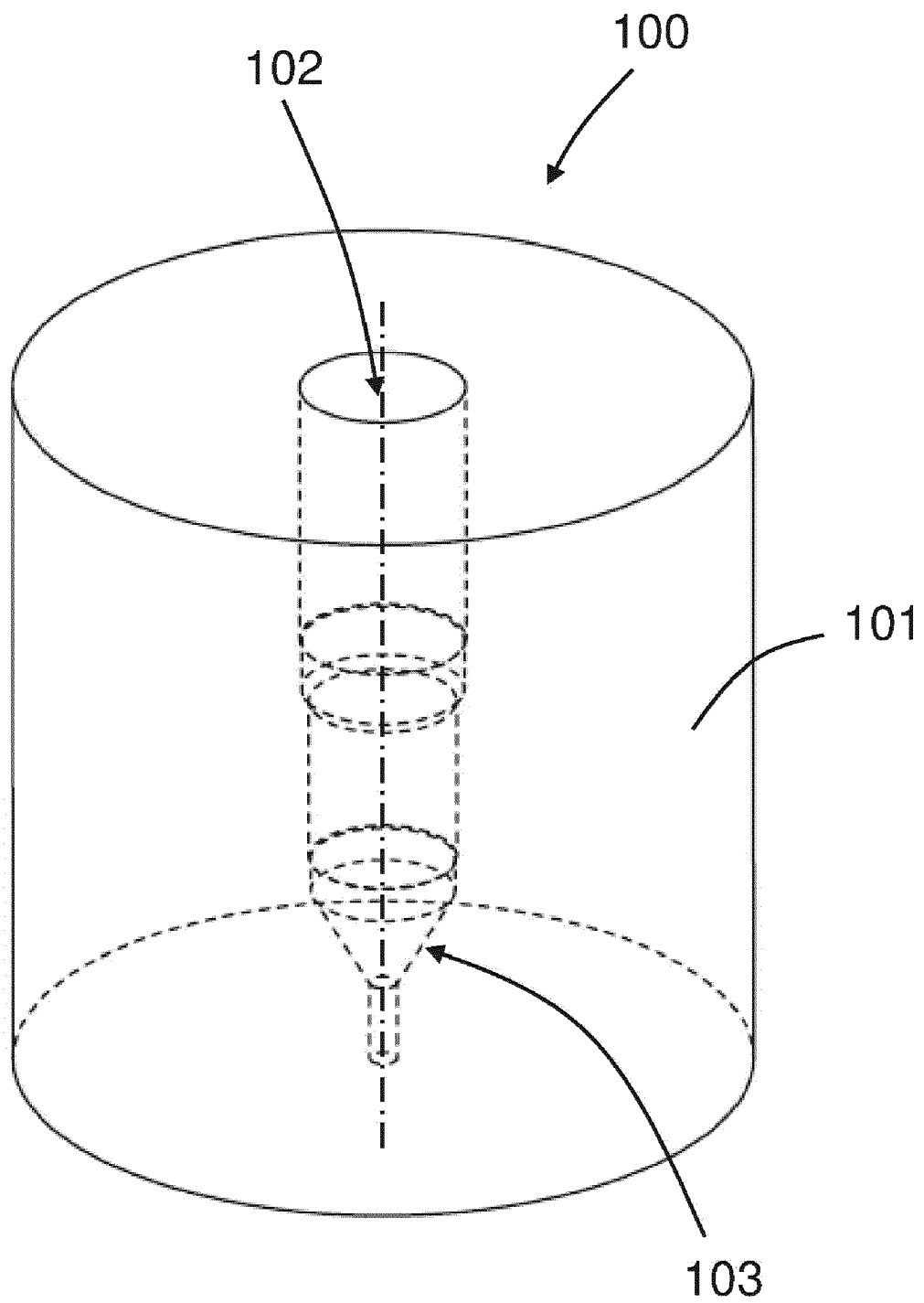


Fig. 8



EUROPEAN SEARCH REPORT

Application Number

EP 23 16 7040

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	US 5 697 405 A (DORNIER PETER D [DE] ET AL) 16 December 1997 (1997-12-16) * figures 1-5 * * column 2, line 53 - column 3, line 8 * * column 3, line 38 - column 4, line 38 * -----	1-15	INV. D03D47/30
A	EP 2 014 808 A2 (TSUDAKOMA IND CO LTD [JP]; TSUDAKOMA SHANGHAI CO LTD [CN]) 14 January 2009 (2009-01-14) * paragraph [0007] - paragraph [0011] * * paragraph [0032] - paragraph [0038] * * figures 2-9 * -----	1-15	
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A	EP 2 778 268 A1 (TOYOTA JIDOSHOKKI KK [JP]) 17 September 2014 (2014-09-17) * paragraph [0017] - paragraph [0019] * * figures 1-7 * -----	1-15	D03D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 14 September 2023	Examiner Hausding, Jan
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